

Protozoa the response to stimuli exhibited by their protoplasm is not simply one of reaction to external stimuli, but is of such a nature that a *purposive* function seems to be postulated, and that protoplasm, even in very lowly forms, as undoubtedly is the case in higher ones, is able to store impressions—possesses, in fact, the rudiments of a memory. From the undifferentiated condition, the next step forward is the development of a rudimentary nervous system, such as occurs in the sponges, then the development of well-marked nervous tissue, its aggregation into ganglionic masses, and eventually the formation of a definite though simple nervous system is traced through the invertebrates, and, finally, the progressive evolution of a nervous system through the vertebrates, culminating in man with his elaborate psychical processes.

Although some would hold that the response of protoplasm to external stimuli is simply one of reaction, we think that the author's view of purposive action in addition is borne out by the facts cited, and that this is inherent in protoplasm, just as the tendency to variation appears to be. With regard to the second part of the book, we are not in a position to criticise its historical accuracy, but it makes interesting reading. The emotional and instinctive qualities displayed by the Irish Celts depends, according to the author, on their hereditary characters rather than on experience and on intellectual acquirements. The book is pleasant and instructive reading, and though here and there not altogether free from error, on the whole is a simple and well-developed exposition of the subject of which it treats.

ANIMAL PSYCHOLOGY.

- (1) *L'Evolution de la Mémoire*. By Henri Piéron. Pp. 360. (Paris: Ernest Flammarion, 1910.) Price 3.50 francs.
- (2) *Vorlesungen über Tierpsychologie*. By Prof. Karl Camillo Schneider. Pp. xii+310. (Leipzig: W. Engelmann, 1909.) Price 8 marks.

(1) **M**. PIÉRON'S book is a new addition to that "Bibliothèque de Philosophie scientifique," and is quite worthy of its place. Its subject is, to say the least, a difficult one, being dependent on the careful interpretation of vast quantities of scattered observations and researches made by students of comparative psychology during quite recent years; but M. Piéron has produced out of this material, some of which is furnished by researches of his own, a volume which is not only compact and thoroughly sound, but also readable.

In an excellent introduction, he criticises certain definitions of memory that have been held in the past, and shows by the help of numerous and interesting examples the continuity, the complete lack of hiatus, in the succession of phenomena commencing with the inorganic memory shown in viscosity, hysteresis, &c., through biological memory, heredity, adaptation, &c., to psychological memory, which is frequently alone allowed the designation memory.

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The presence of consciousness in psychological memory is important, but not of that essential significance which the more metaphysically-minded among the psychologists are so fond of attributing to it. This is quite clearly shown in researches on the memorising of nonsense syllables (Ebbinghaus) where the curve representing the number of repetitions necessary for completely learning series of varying lengths is found to belong to the same type, to have the same mathematical equation, as that representing monomolecular autocatalytic reactions in chemistry, viz., $\log x = Kt + b$.

The contrast, in fact, is not between subhuman and human memory, but one between memory as it is for the individual himself as he enjoys it in consciousness, and memory as it manifests itself objectively both in himself and in his fellow-man.

The author proceeds to consider the phenomena more in detail, commencing with an interesting description of the "persistences rythmiques" displayed by both plants and animals. In the case of the latter, the best examples are given by marine animals, which live on the seashore and reproduce in their organic functions the rhythm of the tides. The rhythm persists when the animals are removed to a new, non-rhythmical environment, although an observer has found that this is not the case with young individuals that have not experienced the tidal rhythm. Piéron has some interesting comments and criticisms to make on the whole problem.

There follows a clear and concise account of the modern experimental methods of research employed to investigate the processes of adaptation and the formation of habits in animals, and the important researches of Thorndike, Hobhouse, Yerkes, and others are usefully summarised. A chapter on "sensory memory," full of experimentally determined results, completes the part of the volume allotted to subhuman psychology.

The last hundred pages of the book deal with specifically human memory, and summarise in small space an enormous number of experimental investigations. The author points out that the laws of rate of learning and forgetting admit of identical mathematical expression for animals and for men, for the different forms of sensorial and motor memory, &c. The curves correspond to the same general mathematical formula, viz., $y = A/K - Bx$. The non-correspondence of memory and intelligence is noted, and pathological modifications are adequately treated. With a useful chapter on the utilisation of memory, and a conclusion, written in more speculative mood, the book ends.

(2) Prof. Schneider gives in his series of published lectures a very full and decidedly original account of the subject-matter of animal psychology. Regarding the physiological mechanism of the nervous system as capable of producing summation of stimuli only, he finds himself forced to assume an active and efficient "Psyche" to explain most of the phenomena of his science. "Die Psyche assoziiert die einzelnen Eindrücke, die dabei ihre Selbständigkeit wahren (Assoziationsorgan), während das Gehirn sie sum-

miert und dabei die einzelnen in ihrer Sondernatur vernichtet (Summationsorgan)" (p. 292). Final causes are postulated. "Ohne Berücksichtigung von Finalia ist ein Verständnis auch der einfachsten Amöbenhandlung unmöglich." His account of instinct, therefore, is through and through teleological. The ends pursued are not to be explained from experience, on one hand, nor are they explicable in terms of organisation as a product of evolution. They can only be accounted for in terms of an "Allgemeinbewusstsein," or "Weltvernunft," an absolute consciousness. Kant and Hartmann are referred to more than once, nor is Hegel omitted. Those men of science to whom metaphysics is anathema, and those (a class comprising much the same people) to whom it is a *terra incognita*, will reject much of the book as unsound. For others the book will be found full of suggestions and new points of view.

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SCALE MOSSES.

The Liverworts, British and Foreign. By the Right Hon. Sir Edward Fry, G.C.B., with the assistance of Agnes Fry. Pp. viii+74. (London: Witherby and Co., 1911.) Price 2s. 6d. net.

IT is a pleasure to welcome the little volume on liverworts, to which scale mosses, as well as the more familiar Thallose forms, like *Marchantia*, belong. Sir Edward Fry has long been known as one who takes a keen interest in mosses, and this new little book on an allied group of plants will appeal to those amateurs who like to know something at first hand of the less easily studied objects of nature. In truth, the liverworts are fascinating plants, for they stand at the parting of the ways where the higher forms branch off from the lower series of primitive groups. They are, however, not easy to study, for they need a keen eye to detect them, and they are, many of them, very difficult to identify.

The authors have done good service in giving a popular and attractive account of the family. The variety of forms, no less than the suggestive differences in their organisation, pointing as it does towards higher vegetative development, will commend the group as a whole to the attention of many who may have avoided it on account of the difficulties which have to be surmounted in making a first acquaintance with the plants composing it.

When the book is critically examined there are not unnaturally points in which one may differ from the authors. The affinity between *Calobryum* and *Monoclea* is really artificial, and they are not generally regarded as closely related. Recent work indicates that the former is more naturally placed near *Haplomitrium*, whilst a considerable difference of opinion exists as regards *Monoclea*, some considering it as near the *Marchantiaceæ*, others as belonging to the *Jungermanniaceæ* in the wider sense.

As regards the origin of elaters, probably the *Riccia-Corsinia* series affords a better clue than the more specialised *Anthocerotaceæ*, but it may perhaps

be argued that this is, after all, rather a matter of opinion than of proven conclusion. We feel inclined, however, to take exception to the comparison between the stomata of the grass-like sporophyte of *Anthoceros* and those of the thallus of *Marchantia*, which belongs to the other—the gametophyte—stage in the life-history. The similarity between the two organs is very slight, and although they perform the same function the mode of origin is quite different in the two cases.

But these are small matters in a book which is written for the amateur rather than for the professed botanist, though the latter will also find it worth reading. There are a few misprints which might be corrected—one of them, *Trichoclea* for *Trichocolea*, occurs several times—when a new edition is called for. In the meantime, we can congratulate the authors on having written an interesting little book on a difficult series of plants.

REFRACTORY MATERIALS AND PRODUCTS.

Fabrication et Emploi des Matériaux et Produits réfractaires utilisés dans l'Industrie. By Prof. A. Granger. Pp. iv+378. (Paris Ch. Béranger, 1910.) Price 15 francs.

THE scientific study of firebricks, furnace blocks, crucibles, and other refractory products is one of increasing importance. The progress of metallurgy, of glass-making, of pottery—even the development of the domestic firegrate—demands scientific, as opposed to rule-of-thumb, knowledge of refractory materials and how they may be best applied to the requirements of different industries. Although many excellent refractory products are made in these islands, the scientific study of the subject as a whole has received but little attention as compared with that given to it in Germany, France, and the United States. A few years ago Dr. J. W. Mellor, of the Pottery Laboratory at Stoke-upon-Trent, endeavoured to set up a committee for the study and standardisation of firebrick and refractory materials, and his work is now being carried on, we believe, by a committee of the Iron and Steel Institute, but it appears likely that some considerable time must elapse before we have an English text-book dealing with the subject as fully and as concisely as this French work.

Mr. Granger is well known as the professor of ceramic technology in the school attached to the State porcelain works at Sèvres, and in all his works one recognises the hand of the teacher who finds it necessary to compile a text-book for his students. This is at once the strength and weakness of such a volume. With the usual logical accuracy and perspicacity of a French writer, the author gives an excellent review of his subject. He treats of every variety of refractory material, fireclays, chromite, magnesia, and aluminous products, including the newest materials prepared for electric furnace work.

The book contains a series of excellent illustrations of the various forms of machinery especially adapted for the treatment of fireclays, &c., and the chapter on kilns and methods of firing, which are of extreme